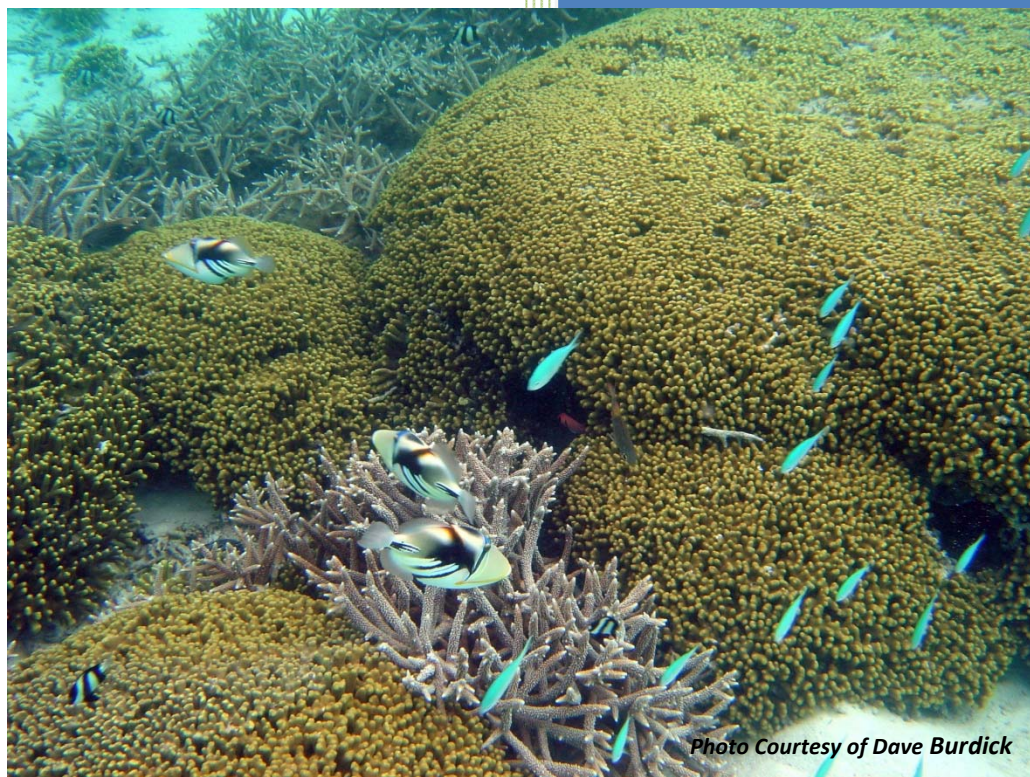




Guam's FY 2017 Coral Reef Initiative



Bureau of Statistics and Plans

May 2017 (Revised)

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Grant Recipient Information:

William C. McDonald, Acting Director
Email Address: william.mcdonald@bsp.guam.gov
Contact Number: 671 472-4201/2/3
Facsimile Number: 671 477-1812

a) Applicant Organization: Bureau of Statistics and Plans, Government of Guam

b) Primary and alternate points of contact:
Primary: Lola E. Leon Guerrero
Alternate: Andrea Hershberger

c) Contact information including address, phone number, and e-mail address:

Bureau of Statistics and Plans
PO Box 2950
Hagatna, Guam 96932
Contact Number: 671 472-4201/2/3
Facsimile Number: 671 477-1812
Primary Email Address: lolalg@bsp.guam.gov
Alternate Email Address: andrea.hershberger@bsp.guam.gov

d) Recipient Grant Manager:

Lola E. Leon Guerrero
Chief Planner
Bureau of Statistics and Plans
PO Box 2950
Hagatna, Guam 96932
Contact Number: 671 472-4201/2/3 and 671 475-9675 (direct)
Facsimile Number: 671 477-1812
Email Address: lolalg@bsp.guam.gov

e) Guam's ASAP Identification Number for DOI CRI: 1141617

f) Geographic Location: Guam

g) Federal funding requested: FY 2017 \$95,000

h) Award start date and award period: *October 1, 2017 to September 30, 2019*

Introduction

Guam's coral reef resources are both economically and culturally important to the residents of Guam. It provides numerous goods and services that support Guam's culture and traditions, tourism and recreation, fisheries, and shoreline and infrastructure protection. Approximately 108 km² of shallow coral reef area is found within 3 miles of Guam, with an additional 110 km² occurring between 3 and 200 miles. As a result of Guam's local law creating five Marine Preserves to combat fishery declines, the fish stocks in the preserves have increased significantly. Despite the critical importance of Guam's coral reefs to many aspects of life on Guam, the island's reef still remain under assault from sedimentation from upland soil erosion, stormwater runoff and associated pollutants, marine debris, coral bleaching, coral disease, recreational misuse, climate change or severe weather condition, and more¹.

The Bureau of Statistics and Plans and the Governor of Guam's Point of Contact for coral reef conservation activities, Guam Visitor's Bureau, and Guam's Natural Resource Agencies continues to promote awareness to the importance of Guam's coral reef ecosystem to the island community and to work and collaborate with the public and private sectors, non-profit organizations, businesses, and educational institutes to encourage best management practices of coral reef conservation efforts. The project tasks being requested for funding will be used to promote sound management and protection of coral reefs in Guam for their long term economic and social benefits.

1) Priority Project: Mapping of Guam's priority coral reefs to inform management decisions and improve outreach

Statement of Need

Piti's Tepungan Bay and Tumon Bay are two of five marine protected areas in Guam. The reefs in these areas support major tourism activities, cultural uses and recreational opportunities for residents and visitors alike. Despite the importance of these areas, neither has been fully mapped to a level of detail sufficient to support proposed management strategies such as use zones and equipment limitations for sensitive areas. This project will address this gap by providing high resolution maps that may be used to create appropriate and effective zones to promote sustainable, responsible use of the area while protecting important natural resources.

While local resource managers have long recognized the need to address impacts associated with various uses (NOAA CRCP 2010), local agencies have not had the capacity to map the corals at a high level of detail. This project will produce a 3D orthorectified model of the shallow water (<3.5m) coral reef ecosystems in Tumon Bay and Piti Bombholes. These 3D models may be printed, creating a tactile diorama that may be used for outreach and education, increasing the understanding of the coral reefs by various audiences, including key decision makers. More importantly, the final data products can enable accurate and quantitative health assessment capabilities for coral reef ecosystems at the reef-scale, or cm-resolution, over regions tens of square kilometers in area. The accurate and automated determination of percent cover and

¹ Guam, Bureau of Statistics and Plans. *Status of the Coral Reef Ecosystems of Guam*. No.1, December 2009.

morphology distribution at cm-resolution may lead to a significantly improved understanding of reef ecosystem dynamics and responses in a rapidly-changing global climate (Li and Chirayath 2016).

The UOG Marine Lab has in situ coral reef monitoring sites in the Piti and Tumon Bay Preserves. Their data may be cross-checked with the results of this project.

Project Description

The project will occur primarily in Piti's Tepungan Park, and Tumon Bay. Dr. King and Mr. Burdick will work with Dr. Ved Chirayath to collect data over a two-week period between May and August 2018. During that time, Mr. Burdick and his monitoring assistants and Dr. King and her remote sensing research assistants will be shadowing Dr. Chirayath's team in Guam. Dr. Chirayath will take the collected data back to the Laboratory of Advanced Sensing at NASA Ames Research Center for processing at the super computer and return the final product: high resolution 3D model of the shallow water coral reef ecosystems at the Piti and Tumon Marine Protected Areas.

Dr. Chirayath, a research scientist at the NASA Ames Laboratory, located in California developed a theoretical model and algorithm called "Fluid Lensing". Chirayath and Earle (2016) used fluid lensing to map shallow water coral reefs on Ofu Island in American Samoa at a sub-cm scale, using an unmanned aerial vehicle (UAV) and high-resolution camera. Fluid lensing removes optical distortions caused by moving water, improving the clarity of the images taken of the corals below the surface of the water. For more information about fluid lensing please visit the following Web sites: <https://www.nasa.gov/ames/las/fluid-lensing-seeing-through-waves> and <https://www.nasa.gov/ames/las/coral-classification>

These high-resolution images may be used to create a three-dimensional model of the coral reef ecosystem using Structure for Motion (SfM). SfM is a photogrammetric method for creating three-dimensional models of a feature or topography from overlapping two-dimensional photographs taken from many locations and orientations. This technology has existed in various forms since 1979 (Ullman, 1979), but applications were uncommon until the early 2000's (Snavely et al., 2008). Westoby et al., (2012) find SfM to be a revolutionary, low-cost, user-friendly, effective, and flexible photogrammetric technique for obtaining high-resolution datasets at a range of scales that represents a major advancement in the field of photogrammetry for geoscience applications. In addition to ortho-rectified imagery, SfM produces a dense point cloud dataset that is similar in many ways to that produced by airborne or terrestrial LIDAR.

In addition to the fluid lensing, Dr. Chirayath will be using **MiDAR**, a next-generation remote sensing instrument that provides real-time multispectral video using an array of LED emitters coupled with NASA's FluidCam Imaging System. MiDAR will enable active Fluid Lensing for multispectral underwater imaging from remote sensing platforms. One band MiDAR will be employing will be the UV band, which will allow for the detection and quantification of dead coral tissue and live coral tissue (Chirayath 2017, personal communication). The use of MiDAR will add an important element to the 3D maps and may prove extremely useful in future applications for Guam's coral response team to understand the severity and magnitude of coral bleaching events.

Project Goals and Objectives

This proposal seeks to provide a high resolution 3D model of the shallow water coral reef ecosystems at the Piti and Tumon Marine Protected Areas. This information will be provided to coral managers, the Guam Visitors Bureau, Guam Department of Parks and Recreation, the Guam Museum, the Guam Coastal Management Program, high school teachers, and the UOG Marine Laboratory to help guide strategies to reduce impacts on two of Guam's most important local reefs. The maps will support management strategies such as use zones for these two important recreational areas.

Given the large number of visitors and residents who use these two reefs, the 3D maps will also be an important outreach tool to showcase these two sites and help promote more responsible use of the area. If the maps are printed on a 3D printer they will be an important and unique addition to existing outreach efforts.

Project Outcomes and Products

The project team will produce the maps as well as a final report including the recommendations for integrating this material into existing monitoring and management documents. Additionally, any materials developed for outreach will be made available to managers, dive operators and other interested stakeholders.

References

Chirayath, V., Earle, S.A., 2016. Drones that see through waves – preliminary results from airborne fluid lensing for centimetre-scale aquatic conservation. *Aquat. Conserv. Mar. Freshw. Ecosyst.* 26, 237–250. doi:10.1002/aqc.2654

Snavely, N. , Seitz, S.M., Szeliski R. Skeletal Sets for Efficient Structure from Motion. *CVPR* 2008.

Ullman, S. 1979. The interpretation of visual motion. Cambridge MA: MIT Press.

Westoby, M.J., Brasington, J., Glasser, N.F., Hambrey, M.J., Reynolds, J.M., 2012. “Structure-from-Motion” photogrammetry: A low-cost, effective tool for geoscience applications. *Geomorphology* 179, 300–314. doi:10.1016/j.geomorph.2012.08.021

Project Timeline

This project is expected to commence October 1, 2017 to September 30, 2019

Projects/Tasks	Oct Dec17	Jan Mar18	Apr Jun18	Jul Sep18	Oct Dec18	Jan Mar19	Apr Jun19	Jul Sep19
Establish Grant Award								
Establish MOU between BSP and UOG								

Projects/Tasks	Oct Dec17	Jan Mar18	Apr Jun18	Jul Sep18	Oct Dec18	Jan Mar19	Apr Jun19	Jul Sep19
UOG will contract services with Dr. Chirayath								
Dr. King and Mr. Burdick will work with Dr. Ved Chirayath to collect data over a two-week period between May and August 2018								
Final report with map and recommendations for integrating this material into existing monitoring and management documents.								
Submit programmatic and financial report to BSP								

Budget and Justification

Task 1	Budget Item	Funding
Personnel	Romina King, PhD (40 hours at \$34/hour)	\$1,360.00
Fringe Benefits	Romina King (59%)	\$803.00
	Contract with Ved Chirayath, NASA Ames	\$49,500.00
Contractual	Laboratory	
	TOTAL	\$51,663.00
<p>The Principal Investigator will be responsible for implementing the project, preparing the progress reports.</p> <p>The University of Guam will enter into a contract with Dr. Chirayath for the use his equipment for the project. The costs are substantially lower than they would be if the University of Guam were to purchase the necessary equipment for this effort. Dr. Chirayath also intends to leverage additional funding from NASA if this proposal is approved.</p>		

Project Manager or Principle Investigator

Principle Investigator:

Romina King, PhD
Assistant Professor of Geography, University of Guam;
NASA Guam EPSCoR Associate Director
Email: roking@triton.uog.edu
T. 671.686.0946

Ved Chirayath, PhD
Research Scientist
Laboratory for Advanced Sensing – Earth Science Division
NASA Ames Research Center
Email: ved.chirayath@nasa.gov
T. 650.604.6278

Collaborator:

Dave Burdick
Guam Long-term Coral Reef Monitoring Coordinator
Marine Laboratory - University of Guam
Email: burdickdr@hotmail.com

2) Priority Project: Coral Reef Outreach and Education

Narrative Description

Effective and measured public outreach and education is a critical need for many natural resources agencies dealing with threats to coral reefs on Guam. Various partners in the Guam Coral Reef Initiatives Coordinating Committee, Government of Guam Agencies of the Guam First Advisory Council and Commission, Guam Nature Alliance (former Environmental Education Committee), the Environmental Education outreach professionals and various Local Action Strategy groups agree that public education and outreach is essential. In addition to that stated need, many government agencies such as the Department of Agriculture, Guam Environmental Protection Agency (EPA), University of Guam (UOG) Marine Lab, and Department of Parks and Recreation lack the trained staff and time to complete the amount of effective outreach and education.

In order to manage the protection of Guam's coral reefs, engaging the community to be aware and to know how important coral reefs are to the island's culture and to Guam's striving economy must continue. Funding is needed to continue to support Guam existing coral reef public outreach and education activities and campaigns to educate, engage and bring awareness to the community.

Statement of Need

Due to a lack of local resources, a need continues to exist to build upon Guam's educational and outreach efforts to raise public awareness and appreciation for Guam's coral reef ecosystems, to promote and support local education and outreach activities on coral reefs, and to engage the communities involvement on coral reef issues in partnership with the Government of Guam's natural resource managers, the local educational institutions, the Federal natural resource managers, and the Guam Nature Alliance. This is important because education and outreach plays a crucial role in protecting our coral reefs.

The funding will support the following public outreach and educational activities and workshops:

- Conduct and support coral reef conservation efforts, reef resilience outreach and education efforts to include public outreach campaign on "Munga ma Songge Guahan", "Eyes on the Reef", and "Ridge to Reef";
- Support for the University of Guam's Island Sustainability Conference that has been a venue to highlight Guam's coral reef grant funded projects; and
- Support for the Guam Nature Alliance (GNA) outreach, education, and awareness activities that promote environmental education on land resources, ocean resources and water resources that engages the community to learn more about Guam's environment.

Project Goal and Objectives

The goal of this project is to enhance Guam's educational and outreach efforts to raise public awareness and appreciation for Guam's coral reef ecosystems. The objectives of this project are to provide support for public outreach and education activities through the coordination of the Guam Nature Alliance outreach events, and support for other related activities to promote coral reefs.

Task Outcome and Products

- Successful support provided to Guam Natural Alliance to engage and educate the community about Guam's land, water, and ocean resources.
- Successful support and implementation of coral reef conservation outreach and education efforts, reef resilience outreach and education efforts, and environmental education outreach efforts.

Budget and Justification

Task 2	Budget Item	Funding
Contractual	(230) Printing of Outreach and Inreach, Educational and Training Materials to include posters, brochures, fact sheets, training materials, and handouts, water bottles, recycled reuse bags with educational message on coral conservation efforts, protect our corals, do not step on the corals and public outreach campaign on "Munga ma Songge Guahan", "Eyes on the Reef", "Ridge to Reef"	\$4,352.00
Contractual	(230) UoG Center for Island Sustainability Annual Conference - Highlight of Coral Project \$5000; 20 registration fee x \$75	\$5,750.00
Total Budget:		\$10,102.00

Contractual support for outreach and educational items are needed to enhance, to develop and to maintain existing outreach and educational materials that will be utilized to educate and to increase public awareness, appreciation and community support for Guam's coral reef conservation efforts. The contractual items will have educational message displayed and campaigns to promote the protection and conservation of Guam's coral reef that will be utilized to engage and bring awareness to the community. The contractual support will include to include posters, brochures, fact sheets, training materials, and handouts, water bottles, recycled reuse bags, pencils, book markers, coloring books, folders, stickers with educational message on coral conservation efforts, protect our corals, do not step on the corals and public outreach campaign on "Munga ma Songge Guahan", "Eyes on the Reef", and "Ridge to Reef.

Contractual support is needed for the UOG Center for Island Sustainability Conference as this is a venue used to highlight and educate the community on Guam's coral reef conservation efforts to include registration fee for staff and guardians of the reef and other networking partners.

Project Timeline

This project is expected to commence October 1, 2017 and to be completed by September 30, 2019.

Projects/Tasks	Oct Dec17	Jan Mar18	Apr Jun18	Jul Sep18	Oct Dec18	Jan Mar19	Apr Jun19	Jul Sep19
Establish Grant Award								
Obtain price quotations, encumber funds for supplies and contractual services and contractual items								
Receive and implement supplies and contractual services and contractual items								
Implement public outreach and education activities								

3) Priority Project: Tasi Beach Guides

Narrative Description

The project will occur primarily in Piti's Tepungan Park, or "Piti Bombholes," the most common access point to the Piti Marine Preserve and a major center for commercial dive tours on Guam. The Center for Island Sustainability's Tasi Beach Guide Program will hire and train staff to

conduct human use monitoring at the site, as well as additional outreach efforts to promote responsible recreation on the island's reefs. The project activities will involve the following:

1. The Tasi Beach Guides will work with NOAA's Coral Management Liaison and the Guam Community Coral Reef Monitoring Program to refine human use monitoring protocols for use at Tepungan Park. Observational surveys will be conducted on a regular basis with an emphasis on the three peak arrival periods in March, August and December.
2. Tasi Beach Guides will develop and present outreach material to encourage responsible recreational use. Outreach efforts may include existing festivals and public events, classroom or targeted audience presentations, or direct interactions with beach goers at the Piti site or other heavily used recreational beaches.

Statement of Need

Guam's fringing coral reef systems support sustenance and commercial fishing activities, recreational and cultural opportunities, and a significant section of the tourism industry that drives the island's economy. However, these activities may also adversely affect these delicate ecosystems. Piti's Tepungan Bay is one of five marine preserves on island and is also one of the most heavily used sites for introductory dives. While local resource managers have long recognized the need to address impacts associated with recreational use (NOAA CRCP 2010), local agencies have not had the capacity to quantify commercial dive use within the Piti preserve. The Guam Visitors Bureau recorded more than 125,000 diving visitors in Fiscal Year 2015 alone (Denight, 2017), but it is not clear how many of these visitors may have used the Piti site. This project will address this information gap by quantifying diver use during peak visitor arrivals and provide managers with information to help shape new strategies to reduce recreational impacts.

Project Goals and Objectives

This proposal seeks to provide a clearer understanding of the number and type of dive operations currently using the Tepungan Park within the Piti Marine Preserve. This information will be provided to coral managers, the Guam Visitors Bureau and the Guam Department of Parks and Recreation to help guide strategies to reduce recreational impacts on one of Guam's most important local reefs. In addition, the Tasi Beach Guides will conduct targeted outreach efforts to promote responsible, sustainable use of the island's reefs.

Task Outcomes and Products:

The project team will produce a final report including the human use survey results and recommendations for integrating this material into existing monitoring and management documents. Additionally, any materials developed for outreach will be made available to managers, dive operators and other interested stakeholders.

Works cited:

Denight, Nathan. "Dive sites benefit Guam." Pacific Daily News 20 Mar. 2017. Web. 28 Mar. 2017.
NOAA Coral Reef Conservation Program. 2010. *Guam's Coral Reef Management Priorities*. Silver Spring, MD: NOAA.

Budget and Justification

Task 3	Budget Item	Funding
Personnel	Associate Director to oversee project up to 1 hour a week at \$35/hour for 52 weeks	\$1,820.00
	Research Assistants to collect and analyze data and conduct outreach. Two assistants at \$14.97/hour for 18 hours weekly for 52 weeks \$14012 salary per assistant	\$28,024.00
Fringe Benefits	Associate Director. Medical/dental, retirement, life insurance and Medicare at 41%	\$747.00
	Research assistants. Social Security (6.2%) and Medicare (1.45%)	\$2,144.00
Supplies	Toner & paper for printing surveys & other misc supplies (clip boards, pens)	\$500.00
Total:		\$33,235.00
<p>Project Manager will be responsible to oversee the implementation of the Tasi Beach Guide.</p> <p>Research Assistants will be responsible to collect the data, analyze the data and to conduct outreach.</p> <p>Supplies such as toner, paper, clipboards essentials items needed to conduct the survey and outreach.</p>		

Project Timeline

The project will commence on October 1, 2017 and will be completed by June 30, 2019.

Projects/Tasks	Oct Dec17	Jan Mar18	Apr Jun18	Jul Sep18	Oct Dec18	Jan Mar19	Apr Jun19
Establish Grant Award							
Procurement and Financial Reporting							
Hire and train staff							
Creation of informational handouts and materials							
Conduct human use monitoring surveys							
Conduct targeted outreach activities							
Submit programmatic and financial report to BSP							
FINAL REPORT							

Projects/Tasks	Oct Dec17	Jan Mar18	Apr Jun18	Jul Sep18	Oct Dec18	Jan Mar19	Apr Jun19
WRITE-UP							
FINAL REPORT SUBMISSION							

Project Manager or Principle Investigator

Else Demeulenaere (Project Manager)
Associate Director
UOG Center for Island Sustainability
(671) 735-2918
elsed@triton.uog.edu

Phil Cruz, (Co Project Manager)
Phillip John R. Cruz
Associate Project Coordinator
UOG Center for Island Sustainability
(671) 735-2918
phillipcruz@triton.uog.edu

Overall FY 2017 Detailed Project Timeline

MONTH	ACTIVITIES
October to December 2017	<ul style="list-style-type: none"> Establish Grant Award (Parent). Anticipated establishment date (1-2 months). Prepare MOU between BSP and UOG Center for Island Sustainability for Tasi Beach Guide (Requires BSP, Subgrantee Agency Head, OAG, and Governor Signature). Prepare MOU between BSP and UOG for Mapping of Guam's priority coral reefs to inform management decisions and improve outreach (Requires BSP, Subgrantee Agency Head, OAG, and Governor Signature). Obtain price quotation and encumber funds for the Public Outreach and Education Support.
January to March 2018	<ul style="list-style-type: none"> Implementation of public outreach and education supplies, and contractual services. MOU between BSP and UOG Mapping of Guam's priority coral reefs to inform management decisions and improve outreach implemented. MOU between BSP and UOG Center for Island Sustainability for Tasi Beach Guide implemented. BSP will conduct subgrantee meeting to address programmatic and financial reporting requirements. BSP (SAA) prepares and submits the CRI semiannual progress report to DOI for October to December 2017 reporting period by the January 30, 2018 due date. BSP Administrative Services Officer prepares and submits the CRI FFR 425 to DOI October to December 2017 reporting period by the January 30, 2018 due date.
April to June 2018	<ul style="list-style-type: none"> Continue to implement public outreach and education activities in collaboration with our NGO and natural resource partners. Highlight Guam's coral reef conservation efforts at the Island Sustainability Conference.
July to September 2018	<ul style="list-style-type: none"> Continue to implement public outreach and education activities in collaboration with our NGO and natural resource partners. BSP (SAA) prepares and submits the CRI semiannual progress report to DOI for January to June 2018 reporting period by the July 30, 2018 due date. BSP Administrative Services Officer prepares and submits the CRI FFR 425 to DOI January to June 2018 reporting period by the July 30, 2018 due date.
October to December 2018	<ul style="list-style-type: none"> Continue to implement public outreach and education activities in collaboration with our NGO and natural resource partners. Tasi Beach Guide Project is complete. UOG CIS will prepare and finalize report for submission to BSP.
January to March 2019	<ul style="list-style-type: none"> Continue to implement public outreach and education activities in collaboration with our NGO and natural resource partners. BSP (SAA) prepares and submits the CRI semiannual progress report to DOI for July to December 2018 reporting period by the January 30, 2019 due date. BSP Administrative Services Officer prepares and submits the CRI FFR 425 to DOI for July to December 2018 reporting period by the January 30, 2019 due date.
April to June 2019	<ul style="list-style-type: none"> Continue to implement public outreach and education activities in

MONTH	ACTIVITIES
	collaboration with our NGO and natural resource partners.
July to September 2019	<ul style="list-style-type: none"> ▪ Continue to implement public outreach and education activities in collaboration with our NGO and natural resource partners. ▪ Mapping of Guam's priority coral reefs to inform management decisions and improve outreach is complete. Prepare and finalize report for submission to BSP.
October to December 2019	<ul style="list-style-type: none"> ▪ Process grant project for closure, prepare final financial and close out narrative reports with deliverables. BSP submit final progress report with deliverables and final financial report.

Priority Listing for Multiple Projects

Priority 1	Mapping of Guam's priority coral reefs to inform management decisions and improve outreach	\$51,663
Priority 2	Coral Reef Conservation Outreach and Education	\$10,102
Priority 3	Tasi Beach Guide	\$33,235
Total Request for Fiscal Year 2017		\$95,000.00

Letter of Support



SENATOR WILLIAM M. CASTRO

I Mina'trentai Kuåtro na Liheslaturan Guåhan

34TH GUAM LEGISLATURE

777 Route 4, MVP Canter Unit 208, Sinajana GU, 96910

Office: 671-969-1225/6 | wilcastro.com

March 30, 2017

Mr. Nikolao Pula

Director

Office of Insular Affairs

U.S. Department of the Interior

1849 C Street, N.W.

Mail-Stop 2429

Washington, D.C. 20240

Re: Guam's Coral Reef Initiative Program 2017 Application

Hafa Adai!

I am writing to express my support for the Guam's Coral Reef Initiative (CRI) Program, and its ongoing efforts to improve the health of Guam's coral reefs and protect them for sustainable use for the People of Guam.

Guam's coral program is focused on improving water quality, maintaining sustainable fishing practices, and addressing invasive species that affect the health of the corals reefs. Projects aimed at lessening land based sources of pollution, erosion, sedimentation, and educating local fishers to improve stock management will help promote the health of the coral reefs and sound management of our island's natural resources.

The CRI represents collaboration of Guam's Natural Resource agencies, all coming together to promote awareness and management of this valuable resource. I fully support these efforts and will continue to work closely with these agencies to support healthier coral reefs and ecosystems through my role as the Governor's Point of Contact for coral reef conservation activities, and as a Senator in the Guam legislature.

Please do not hesitate to contact me at by telephone at (671)969-1225/6/8 or by email at wilcastro671@gmail.com with any questions you may have.

Sincerely,

William M. Castro